BLC 11 March 15, 2014 Ruth Buskirk, University of Texas at Austin

rbuskirk@austin.utexas.edu

**How can we apply primary research in the classroom**

**(beyond laboratory classes). Let me count the ways . . .**

*A few goals (choose yours; think of others)*

• Integrate competencies from *Vision & Change* (hypothesis testing, quantitative reasoning,

modeling, interacting systems) into your course, and incorporate into your curriculum.

• Engage students as active participants in the classroom, practicing those skills.

• Relate primary research to course content. (where did all that textbook info come from?)

• Train students to access primary literature & to evaluate sources, sponsors, transparency

• Promote collaborative thinking and communication, as students talk and gain confidence.

• If these competencies are really important to you, write them into your exams.

*Some types of in-class activities (choose the elements that meet your course goals)*

(a) Show a graph or table from a research paper and ask students how the data could have been gathered; have students state the results and then the conclusions from the graph.

(b) Show a graph or table from a research paper in class, have students explain the data and how the data relate to the overall experiment or model being tested. Ask students if the data match the predictions of the model, or if that experiment is a fair test of the model.

(c) After analyzing a figure or table from a paper, have students discuss what the *next step* in the research should be. What is the next question to ask?

(d) Have students read title and abstract of a paper and then discuss what types of data the paper should present that will justify the conclusions. Ask if conclusions *are* justified.

(e) Students begin by making a concept map of the introduction and define the science issues, then read to elucidate hypotheses, analyze & interpret data. (C.R.E.A.T.E.)

(f) Give students a set of guiding questions to answer as they read a paper, beginning with vocabulary to check, addressing major elements of the study, and tying in to class topics.

(g) Students read through a paper then, in groups, diagram a flow chart of the study.

(h) Pairs of students read and analyze one figure in a paper; other pairs analyze another figure. Two groups get together and share what they have learned and ask questions.

(i) Examine a primary research data set in the context of a larger study and/or societal issues. Then ask the students if they could suggest another way to portray the data and/or how they would present the results in an article for the general public or a legislative or policy committee or a page or figure in a general biology textbook.

(j) Incorporate primary research data into a Case Study narrative for in-class exercise.

(k) Through examples, train students to see the differences between a research report (original data; full methods, results, discussion), a review article, a brief research note, an editor’s note introducing article in *Nature, Cell, Science; a*n editorial letter, a popular article. Distinguish an online publication (PLoS) from a web site.

(l) Show students a short video about the PI on a paper (or if on campus invite him/her to stop by). After reading the paper, have students write two questions to ask the investigator.

*Articles to use today (\*\*in your binder; \* a few copies on the tables)*

\*\* C Both, S Bouwhuuis, CM Lessels, ME Visser. 2006. Climate change and population declines in a long-distance migratory bird. *Nature* 441(4) [pied flycatcher]

\* GA Breed, S Stickter, EE Crone. 2012. Climate-driven changes in northeastern US butterfly communities. *Nature Climate Change* 3: 142-145.

\*\* I-C Chen, JK Hill, R Ohlemuller, DB Roy, CD Thomas. 2011. Rapid range shifts of species associated with high levels of climate warming. *Science* 333, 1024-1026.

\* P. Dee Boersma, GA Rebstock. 2014. Climate change increases reproductive failure in Magellanic Penguins. *PLOS One* 9(1) e85602

\*\* BG Freeman, AM Class Freeman. 2014. Rapid upslope shifts in New Guinean birds illustrate strong distributional responses of tropical montane species to global warming. *Proc. Nat. Acad. Sci*. Epub 2014 Feb 18.

\*\* N Jevanandam, AGR Goh, RT Corlett. Climate warming and the potential extinction of fig wasps, the obligate pollinators of figs. *Biol. Lett.* 9: 201330041.

\*\* SL Pelini, JDK Dzurisin, KM Prior, CM Williams, TD Marsico, BJ Sinclair, JJ Hellmann. 2009. Translocation experiments with butterflies reveal limits to enhancement of poleward populations under climate change. *Proc Nat Acad Sci.* 106(27) 11160-11165.

\* WCEP Verberk, DT Bilton. 2013. Respiratory control in aquatic insects dictates their vulnerability to global warming. *Biol. Lett.* 9: 20130473.

\* G-R Walther, E Post, P Convey, A Menzel, C Parmesan, TJC Beebee, J-M Fromentin, O Hoegh-Guldberg, F Bairlein. 2002. Ecological responses to recent climate change. Review Article. *Nature* 416: 389-395.

*A few references on student scientific literacy and reading primary literature:*

R. Buskirk, C. M. Gillen. *Inquiry in Action, Interpreting Scientific Papers*, supplement to accompany Campbell Reece *Biology*. Pearson.

C. Gormally, P. Brickman, M. Lutz. 2012. Developing a test of scientific literacy skills: measuring undergraduates’ evaluation of scientific information and arguments. *CBE-Life Sci Educ* **11**: 364-377.

Sally G. Hoskins, D. Lopatto, L. M. Stevens. 2011. The C.R.E.A.T.E. Approach to Primary Literature Shifts Undergraduates’ Self-Assessed Ability to Read and Analyze Journal Articles, Attitudes about Science, and Epistemological Beliefs. *CBE-Life Sci Educ* **10**: 368-378. [see subsequent article 2013 *CBE-Life Sci Educ* **12**: 59-72]

A. Hubert, B. T. Jacques-Fricke, S. Miller. A versatile module to improve understanding of scientific literature through peer instruction***.*** *J. Coll. Sci. Teaching* **39**.2 (Nov-Dec 2009): 24.

C.A.R. Kozeracki, M.F. Carey, J Colicelli, M Levis-Fitzgerald. 2006. An Intensive Primary-Literature-based Teaching Program Directly Benefits Undergraduate Science Majors and Facilitates Their Transition to Doctoral Programs. *CBE-Life Sciences Education.* **5:** 340-347

L. Tronsky, L. Wenk. First-year students benefit from reading primary research articles. *J. College Sci. Teaching* **40**.4 (March-April 2011): 60